

COUPLING

Publication number: WO2004031640

Publication date: 2004-04-15

Inventor: WISE CHRISTOPHER RICHARD (GB)

Applicant: PETRO TECHNIK LTD (GB); WISE CHRISTOPHER RICHARD (GB)

Classification:

- **international:** **F16L47/03; F16L47/02;** (IPC1-7):
F16L47/03

- **european:** F16L47/03

Application number: WO2003GB04286 20031006

Priority number(s): GB20020023054 20021004

Also published as:

GB2395242 (A)

AU2003271895 (A1)

Cited documents:

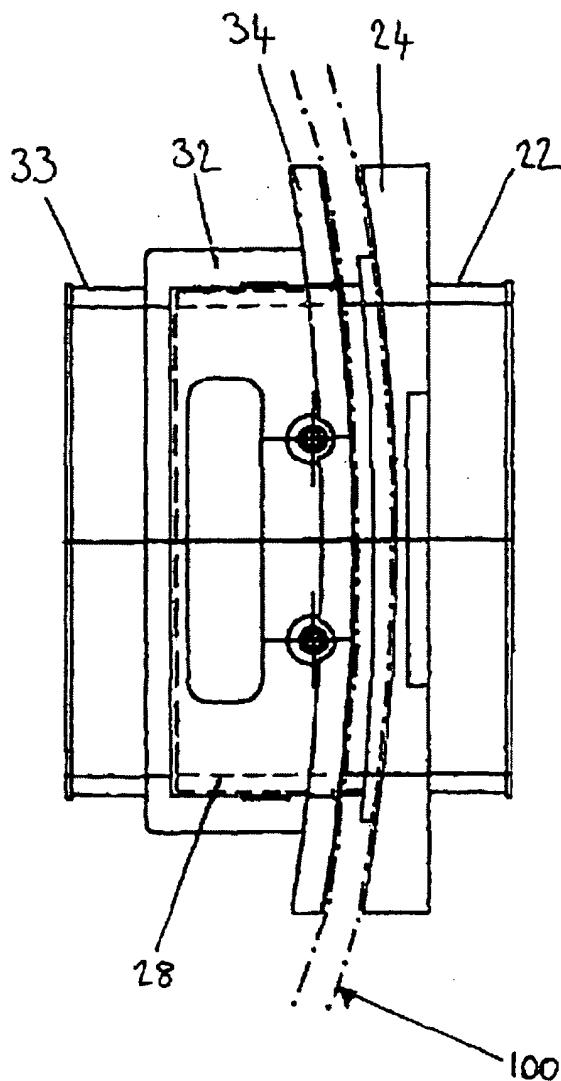
GB2332255

[Report a data error here](#)

Abstract of WO2004031640

The present invention provides a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall (100) and a pipe passing through said opening, said fitting comprising: - (i) a first fitting component (20) to mount to the inner or the outer surface of the chamber wall, having a tubular sleeve (28) adapted to allow the pipe to pass through the sleeve, the first fitting component having a flange or shoulder (24), a first surface (25) of the flange or shoulder being configured to contact the chamber wall around the opening; (ii) a second fitting component (30) to mount to the other of the inner and outer surface of the chamber wall, having a tubular sleeve (32) adapted to allow the pipe to pass through the sleeve and further adapted to pass through the opening in the chamber wall and to inter-fit with the tubular sleeve of the first fitting component, the second fitting component having a flange or shoulder (34), a first surface (36) of the flange or shoulder being configured to contact the chamber wall around the opening, at

least one of the first and the second fitting component (20, 30) further having an energy transfer means (38) incorporated in a mating surface of the tubular sleeve (28, 32) thereof where the tubular sleeve of the first component and the tubular sleeve (32) of the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening.



Data supplied from the **esp@cenet** database - Worldwide

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
15 April 2004 (15.04.2004)

PCT

(10) International Publication Number
WO 2004/031640 A1

(51) International Patent Classification⁷: F16L 47/03 Richard [GB/GB]; 7 Wilding Road, Pinebrook, Ipswich, Suffolk IP8 3SG (GB).

(21) International Application Number: PCT/GB2003/004286 (74) Agent: COATES, Ian, Harold; Sommerville & Rushton, 45 Grosvenor Road, St Albans AL1 3AW (GB).

(22) International Filing Date: 6 October 2003 (06.10.2003)

(25) Filing Language: English (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(26) Publication Language: English

(30) Priority Data: 0223054.8 4 October 2002 (04.10.2002) GB

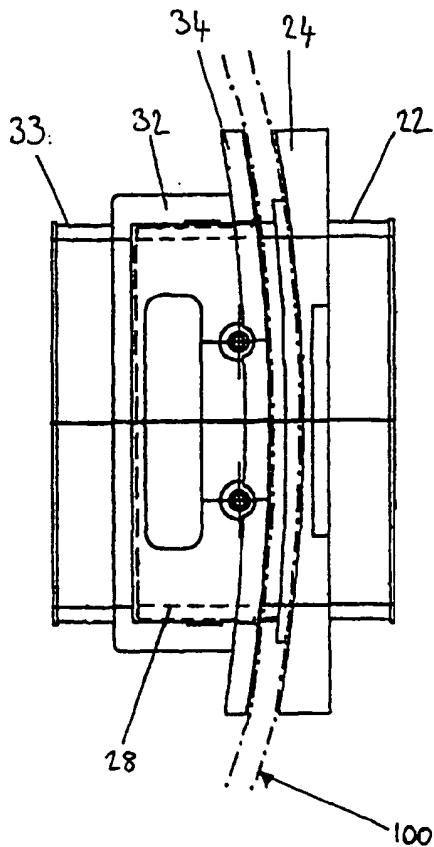
(71) Applicant (for all designated States except US): PETRO TECHNIK LIMITED [GB/GB]; Petro Technik House, Olympus Close, Whitehouse Industrial Estate, Ipswich, Suffolk IP1 5LN (GB).

(72) Inventor; and

(75) Inventor/Applicant (for US only): WISE, Christopher, (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO,

[Continued on next page]

(54) Title: COUPLING



(57) Abstract: The present invention provides a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall (100) and a pipe passing through said opening, said fitting comprising: - (i) a first fitting component (20) to mount to the inner or the outer surface of the chamber wall, having a tubular sleeve (28) adapted to allow the pipe to pass through the sleeve, the first fitting component having a flange or shoulder (24), a first surface (25) of the flange or shoulder being configured to contact the chamber wall around the opening; (ii) a second fitting component (30) to mount to the other of the inner and outer surface of the chamber wall, having a tubular sleeve (32) adapted to allow the pipe to pass through the sleeve and further adapted to pass through the opening in the chamber wall and to inter-fit with the tubular sleeve of the first fitting component, the second fitting component having a flange or shoulder (34), a first surface (36) of the flange or shoulder being configured to contact the chamber wall around the opening, at least one of the first and the second fitting component (20, 30) further having an energy transfer means (38) incorporated in a mating surface of the tubular sleeve (28, 32) thereof where the tubular sleeve of the first component and the tubular sleeve (32) of the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening.



SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *with international search report*

COUPLING

Field of the Invention

5 This invention relates to fittings for providing a seal between a wall and a pipe passing through an opening in the wall, to a method of forming such a seal, and to an assembly comprising the combination of a pipe, a wall and a fitting providing a seal between the two. The invention is particularly applicable, but in no way limited, to the provision of a seal between a pipe and a wall of a manhole chamber as found
10 in a subterranean fuel tank chamber or pump/dispenser sump, for example in a petroleum forecourt installation.

Background to the Invention

15 In petroleum forecourt installations, pipework running between dispensing pumps and a subterranean fuel storage tank passes into a manhole chamber which is generally situated directly above the manhole lid of the tank. The chamber is normally defined by an upstanding wall which, when viewed from above, can be of an octagonal, circular, square or rectangular shape, and which includes apertures
20 through which respective pipes pass.

It is desirable to provide a seal between each of the apertures and its respective pipe to avoid ingress of water into and out of the manhole chamber. To that end, it is known to attach a fitting to a portion of the wall around the aperture
25 and a rubber "boot" that sleeves over the pipe and is clamped to both the pipe and the fitting by, for example, jubilee (TM) clips. Some types of fitting are bolted to the chamber wall, whilst other types of fitting provide inner and outer parts between which the wall is sandwiched, the inner and outer parts being held together by a screw-threaded connector which extends through the aperture. These connectors
30 often incorporate a rubber seal located between a part of the connector and the chamber wall. Similar fittings are used in the sumps situated beneath the dispensing pumps.

A further fitting of this general type is described in GB2 332 255
35 (PetroTechnik Ltd). The entire text of this document is incorporated herein by reference and is intended to form an integral part of this disclosure. This describes

a fitting comprising a tubular sleeve which passes through the chamber wall and a flange extending radially outwards from the sleeve, the flange incorporating electrofusion heating elements. In use the flange is welded to the chamber wall and a fluid tight seal between the sleeve and a pipe passing through it is completed 5 using a conventional rubber boot.

The type of fittings described in GB 2332255 are reasonably effective when the chamber wall is formed from a type of plastics material such as, for example, polyethylene (PE) that is heat weldable and which is thus suitable for forming an 10 electrofusion seal. However, many chambers and sumps are constructed from materials such as glass-fiber reinforced plastic (GRP), fibre reinforced plastic (FRP) and steel, where such a seal is not possible. If a fitting of this type is still to be used then a chemical adhesive must be used instead of electrofusion. Any adhesive used must have a high chemical resistance, and must in particular be resistant to a 15 wide variety of hydrocarbon solvents.

Adhesive selection therefore presents a real problem and whilst some suitable adhesives are available, these inevitably require the various components to be clamped in place for a considerable period of time until the adhesive cures. One 20 such suitable adhesive is 3M Scotch-Weld (RTM) Structural Plastic Adhesive DP-8005 or DP-8010. However, the strength of adhesive bond using this adhesive can take 24 hours to build up. This has a major knock on effect on construction times where clamps must be kept in place for this length of time before other pipes and seals can be fitted.

25

It is an object of the present invention to overcome or mitigate some or all of these problems.

Summary of the Invention

30

According to a first aspect of the present invention there is provided a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting assembly comprising:-

35

(i) a first fitting component to mount to the inner or the outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to

pass through the sleeve, the first fitting component having a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall around the opening;

5 (ii) a second fitting component to mount to the other of the inner and outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to pass through the sleeve and further adapted to pass through the opening in the chamber wall and to inter-fit with the tubular sleeve of the first fitting component, the second fitting component having a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall around the opening, at least one of the first and the second fitting component further having an energy transfer means incorporated in a mating surface of the tubular sleeve thereof where the tubular sleeve of the first component and the tubular sleeve of the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening.

20

Suitably the first surface of the flange of one or both of the first component and the second component is configured to contact the chamber wall around substantially the whole circumference of the opening and over substantially the whole first surface of the flange. This enables, for one or both of the components, a close sealing contact with the chamber wall so that adhesive applied substantially uniformly over that first surface will bond the first surface to the chamber wall and provide the required fluid tight seal between the component and the chamber wall surrounding the opening.

25 30 By applying adhesive to the first surface of one or both of the flanges of the first and second components prior to or at the same time as assembling the first and second components together, with the tubular sleeve of the second component extending through the opening in the chamber wall, the two components can be welded together to hold them in place while the adhesive cures.

35

For each of the first and second component the tubular sleeve may extend from one or both sides of the flange/shoulder of the component but preferably the sleeve extends on both sides for the second component and only one side for the first component.

5

Preferably the mating surface comprises a fusible material which, when heated via the energy transfer means, at least partially melts, causing the fitting and the wall to be fused together. Suitably the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the mating surface.

10 Preferably the energy transfer means comprises a heating wire which is embedded within the mating surface.

15 Suitably the first surface of one or both of the first component and the second component is coated, in use, with an adhesive. Preferably the adhesive is a pressure sensitive adhesive or other curable adhesive which requires several hours to cure.

20 Suitably the sleeve is of a substantially circular cross-section, and the flange or shoulder projects radially outwardly therefrom.

25 The fitting may further comprise a sealing member or boot adapted to form a fluid tight seal between the tubular sleeve of one of the fitting components and the pipe and which is secured at one end to the tubular sleeve.

According to a second aspect of the present invention there is provided a method of forming a seal between an opening in a chamber wall and a pipe passing through said opening, the method comprising the steps of:

30 (a) applying a fitting to the pipe, said fitting comprising:

(i) a first fitting component to mount to the inner or the outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to pass through the sleeve, the first fitting component having a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall around the opening;

(ii) a second fitting component to mount to the other of the inner and outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to pass through the sleeve and further adapted to pass through the opening in the chamber wall and to inter-fit with the tubular sleeve of the first fitting component, the second fitting component having a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall around the opening, at least one of the first and the second fitting component further having an energy transfer means incorporated in a mating surface of the tubular sleeve thereof where the tubular sleeve of the first component and the tubular sleeve of the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening, adhesive being applied to the first surface of one or both of the first fitting component and the second fitting component or the respective contacting surface of the chamber wall ;

(b) applying energy to the energy transfer means and thereby heating the mating surface to cause the first and second components of the fitting to become fused or bonded together to hold them in place relative to each other and relative to the opening, allowing the adhesive to cure.

Suitably the method further comprises applying a respective sealing component to seal between each of the fitting components and the pipe, and which suitably comprises a reduction boot.

According to a further aspect of the present invention there is provided a fitting for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

(i) a first fitting component to mount to the inner or the outer surface of the chamber wall around the opening;

(ii) a second fitting component to mount to the other of the inner and outer surface of the chamber wall around the opening and having a part that passes through the opening in the chamber wall and inter-fits with the first fitting component, an adhesive being applied to one

5

or both of the first fitting component and the second fitting component where they mount to the respective surface of the chamber wall, at least one of the first and the second fitting component further having an energy transfer means incorporated in a mating surface thereof where the first component and the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening.

10 Definitions

In this context the following terms have the meanings given below in addition to their ordinary dictionary meanings:

15 **chamber** – any receptacle designed to keep a fluid in or out. This includes, but is not limited to manhole and sump chambers as described herein. It also includes tanks in general.

energy transfer means – a generic term describing any form of energy source. 20 Typically it takes the form of a resistance winding which heats up when an electrical current is passed through it. The term also encompasses other welding techniques including ultrasonic welding and induction welding.

flange – any collar suitable for attaching a fitting to a chamber wall. In the examples 25 given the surface of the flange which contacts the chamber wall is substantially planar. However, it will be understood that the flange must conform to the profile of the chamber wall around the pipe inlet opening. Thus the flange can adopt any suitable conformation to achieve the necessary contact with a flat or curved surface or even the corner of a container wall.

30

fluid – whilst the examples provided relate mainly to liquids, the term fluid refers to liquids, vapours and gases. For example, should a leak occur in a secondarily contained pipe in a garage forecourt installation then petrol or petrol vapour will collect in the manhole chamber. It is essential that this petrol vapour cannot escape 35 through the wall of the chamber and into the surrounding ground.

pipe – the examples given herein are for a generally circular cross-sectioned single wall pipe. However, the invention also covers other cross-sections such as box sections, corrugated and the like and secondarily contained pipes of the "pipe-within-a-pipe" type. In this case the sealing member or boot for sealing the sleeve to the pipe will be rather more complex. However, such boots are well known in the art.

The invention also encompasses pipes which are not circular in cross-section.

10 tubular sleeve - this term has a very broad meaning. It includes any projection from the flange which substantially encircles a pipe passing through the fitting and which enables a seal to be made between the fitting and the pipe. The flange and sleeve need not be of unitary construction and may, for example, be of two-part threaded construction.

15

Brief Description of the Drawings

The present invention will now be described by way of examples only with reference to the accompanying drawings wherein:-

20

Figures 1A and 1B illustrate plan and elevational views respectively of an underground chamber and sumps associated with three dispensing pump islands;

25

Figures 2A and 2B illustrate side and end views of a first component of the fitting assembly of the present invention;

Figures 3A and 3B illustrate side and end views of a second component;

30

Figure 4 shows the first component and second component in an assembled state around a curved chamber wall (shown in dotted line).

Description of the Preferred Embodiments

35

The present embodiments represent the best ways known to the applicant of putting the invention into practice. However they are not the only ways in which this can be achieved.

Figures 1A and 1B illustrate an underground chamber 10 associated with an underground fuel storage tank (not shown). The tank typically contains a plurality of compartments containing different fuels to be supplied to dispensing pumps (again not shown). The chamber is of a conventional construction and such chambers are known *per se*. Fuel from the fuel tanks is contained and distributed in fuel supply pipes 12 which may be flexible, and thus replaceable, or could be rigid and therefore fixed in place. It is also possible that there may be a plurality of fuel supply pipes within one secondary, outer pipe as described in PCT/GB01/00995, the entire text of which is incorporated herein by reference. It is intended that this text should form an integral part of this disclosure.

Turning now to Figures 2 and 3, these show the main two components of the coupling. In this example the fitting has been designed to fit onto a wall of a substantially circular chamber. A fitting component 20, shown in Figure 2, comprises a substantially cylindrical sleeve 28 designed to fit through a correspondingly sized and shape aperture in a chamber wall (not shown).

A radially extending outwardly projecting flange 24 is provided and one surface face 25 of the flange is designed to be a matching mating fit onto the outside of the chamber wall. In this example the chamber wall is of substantially circular cross section. However, it will be appreciated that the flange can be shaped to conform to any particular chamber wall profile. In use, an adhesive is applied to surface 25, after thoroughly cleaning all surfaces, and the sleeve is passed through the aperture in the chamber wall until the flange surface 25 and the chamber wall make good contact.

The other component 30 of the fitting is shown in Figure 3. This component comprises a sleeve portion 32, having a larger diameter than sleeve 28 such that the internal diameter surface 35 of sleeve 32 and the external diameter surface of sleeve 28 are a tight sliding fit. Sleeve 32 carries at or near one end a flange 34, complementary in shape to the internal surface of the chamber wall.

In use an adhesive is applied to surface 36 after thoroughly cleaning all surfaces, and the sleeve 32 is passed over sleeve 28 from inside the chamber.

An important feature of this invention is that component 30 incorporates a set of electrofusion windings 38 and connector terminal pins 40 and 42. The windings are set at or near the internal surface of sleeve 32 where it contacts sleeve 28 in use.

5

The two components 20 and 30 are then mechanically clamped firmly together with the chamber wall between them and an electrofusion weld is made between sleeve 20 and sleeve 30. Once the electrofusion weld has formed, the mechanical clamp can then be removed and used to make another similar fitting or 10 set aside and construction of the remainder of that joint continued with. There is no need to wait 24 hours for the adhesive to cure. The electrofusion joint thus takes the place of the mechanical clamp, forming what is, in effect, a permanent mechanical clamp. This enables the adhesive to cure under pressure over a prolonged period undisturbed.

15

Sleeve 32 is connected to a further substantially cylindrical sleeve 33 which is slightly smaller in diameter than sleeve 32. This sleeve is adapted for connection to a rubber boot which is used to complete the secondary containment system. Once the electrofusion weld has formed, the integrity of the secondary containment 20 system can be tested. It is also possible that sleeve 22 can itself incorporate electrofusion heating elements/windings (not shown) so that an electrofusion seal can be formed between the fitting and a pipe. Such an arrangement is described in GB 0123817.9, the entire text of which is incorporated herein by reference and which is intended to form an integral part of this disclosure.

25

Figure 4 illustrates the assembled fitting without the rubber boots being shown, but with the chamber wall 100 shown in dotted line.

It will be appreciated that the present invention provides apparatus and a 30 method for joining a pipe to a wall, where the wall is made from a material which cannot readily form an electrofusion seal. Thus the present invention will be applicable in chamber or other walls made from metals such as steel, glass reinforced or other reinforced plastics, other plastics material or even concrete. This is also the first application known to the applicant where a permanent clamp 35 is formed by the electrofusion coupling of two separate fittings.

It will also be appreciated that a wide range of adhesives, both known and yet to be discovered, can be used in this application. Just one example is the range of Scotch-weld adhesives produced by 3M and which includes DP-8008 and DP-8010. The choice of preferred adhesive will be determined by the
5 materials or adhesive specialist.

4. A fitting as claimed in Claim 1, 2 or 3, in which the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the mating surface.

5

5. A fitting as claimed in claim 4, in which the energy transfer means comprises a heating wire which is embedded within the mating surface.

10

6. A fitting as claimed in any preceding claim, in which the first surface of one or both of the first component and the second component is coated, in use, with an adhesive.

15

7. A fitting as claimed in any preceding claim, in which the adhesive is a pressure sensitive adhesive or other curable adhesive which requires several hours to cure.

8. A fitting as claimed in any preceding, in which the sleeve is of a substantially circular cross-section, and the flange or shoulder projects radially outwardly therefrom.

20

9. A fitting as claimed in Claim 4, in which the fitting includes terminals for connecting the energy transfer means to a current supply.

25

10. A fitting as claimed in any preceding claim, wherein the fitting further comprises a sealing member or boot adapted to form a fluid tight seal between the tubular sleeve of one of the fitting components and the pipe and which is secured at one end to the tubular sleeve.

30

11. A method of forming a seal between an opening in a chamber wall and a pipe passing through said opening, the method comprising the steps of:

35

(a) applying a fitting to the pipe, said fitting comprising:

(i) a first fitting component to mount to the inner or the outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to pass through the sleeve, the first fitting component having

a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall around the opening;

(ii) a second fitting component to mount to the other of the inner and outer surface of the chamber wall, having a tubular sleeve adapted to allow the pipe to pass through the sleeve and further adapted to pass through the opening in the chamber wall and to inter-fit with the tubular sleeve of the first fitting component, the second fitting component having a flange or shoulder, a first surface of the flange or shoulder being configured to contact the chamber wall

5 around the opening, at least one of the first and the second fitting component further having an energy transfer means incorporated in a mating surface of the tubular sleeve thereof where the tubular sleeve of the first component and the tubular sleeve of the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening, adhesive being applied to the first surface of one or both 10 of the first fitting component and the second fitting component or the respective contacting surface of the chamber wall ;

15

20 (b) applying energy to the energy transfer means and thereby heating the mating surface to cause the first and second components of the fitting to become fused or bonded together to hold them in place relative to each other and relative to the opening.

25

12. A method according to Claim 11, in which the energy transfer means comprises conduction means for conducting an electric current, said conduction means in use being heated by the current to cause said heating of the first surface.

30 13. A method according to Claim 12 in which the materials constituting the wall and the first surface are such that their surfaces are fused together by a process of electrofusion.

35 14. A fitting for providing a substantially fluid-tight seal between an opening in a chamber wall and a pipe passing through said opening, said fitting comprising:-

5

10

- (i) a first fitting component to mount to the inner or the outer surface of the chamber wall around the opening;
- (ii) a second fitting component to mount to the other of the inner and outer surface of the chamber wall around the opening and having a part that passes through the opening in the chamber wall and interfits with the first fitting component, an adhesive being applied to one or both of the first fitting component and the second fitting component where they mount to the respective surface of the chamber wall, at least one of the first and the second fitting component further having an energy transfer means incorporated in a mating surface thereof where the first component and the second component inter-fit, said energy transfer means being adapted to heat the mating surface in order to weld the first component to the second component to hold them in place relative to each other and relative to the opening.

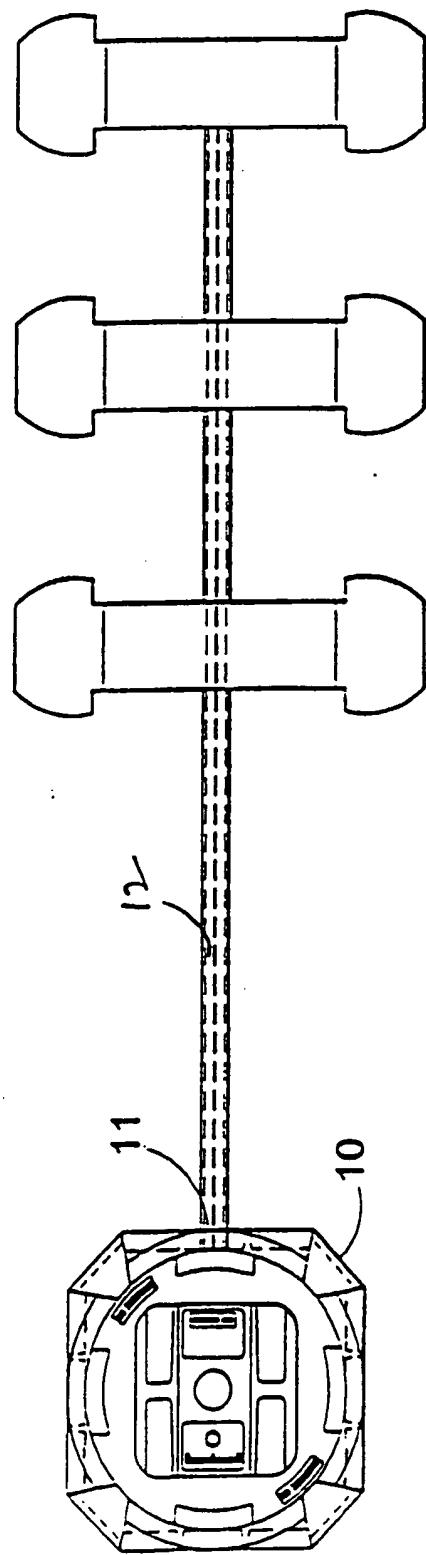


Fig. 1A

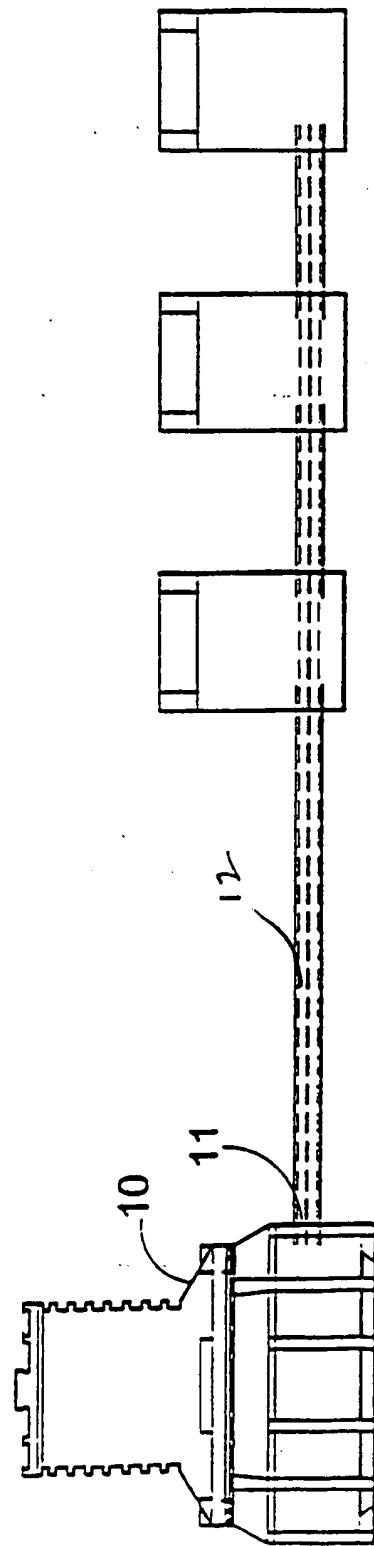


Fig. 1B

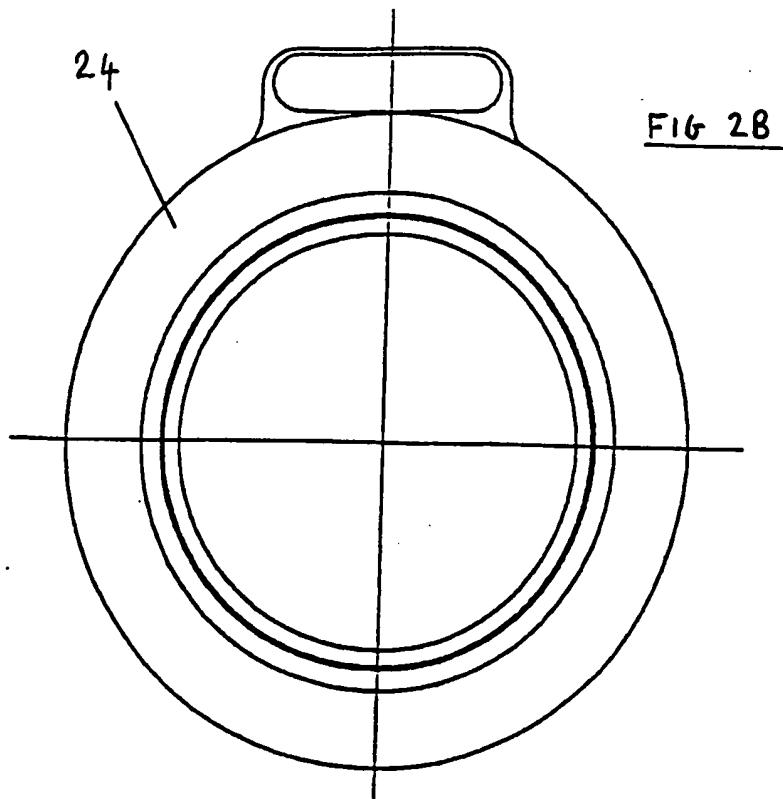
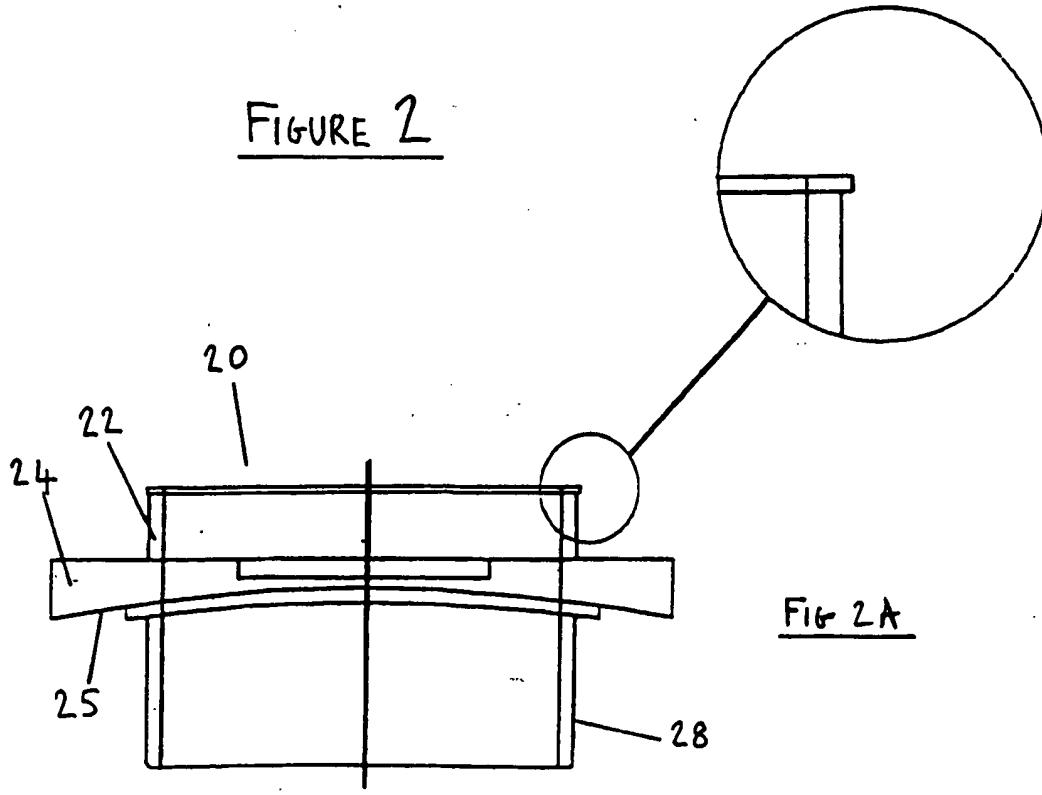
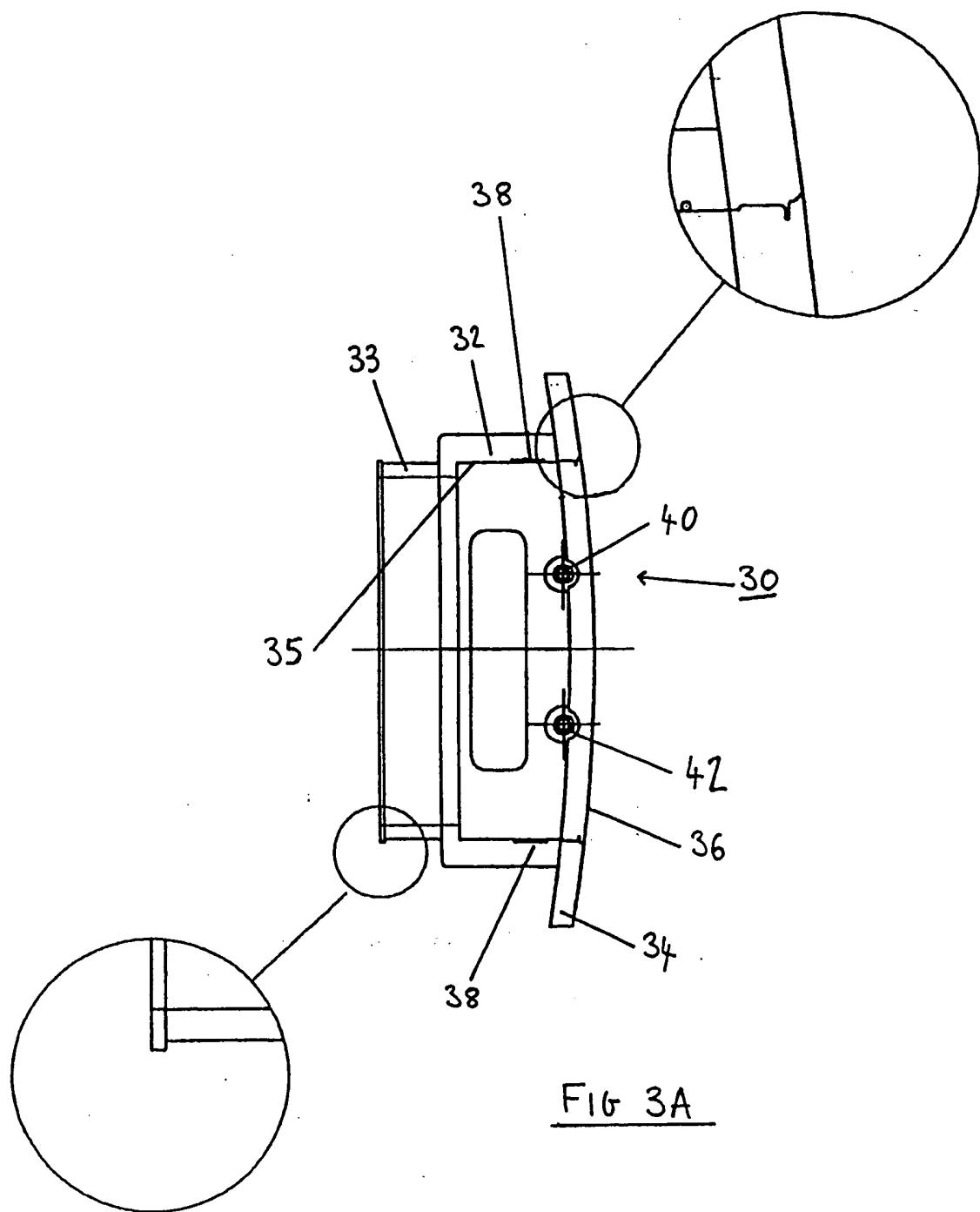


FIGURE 2





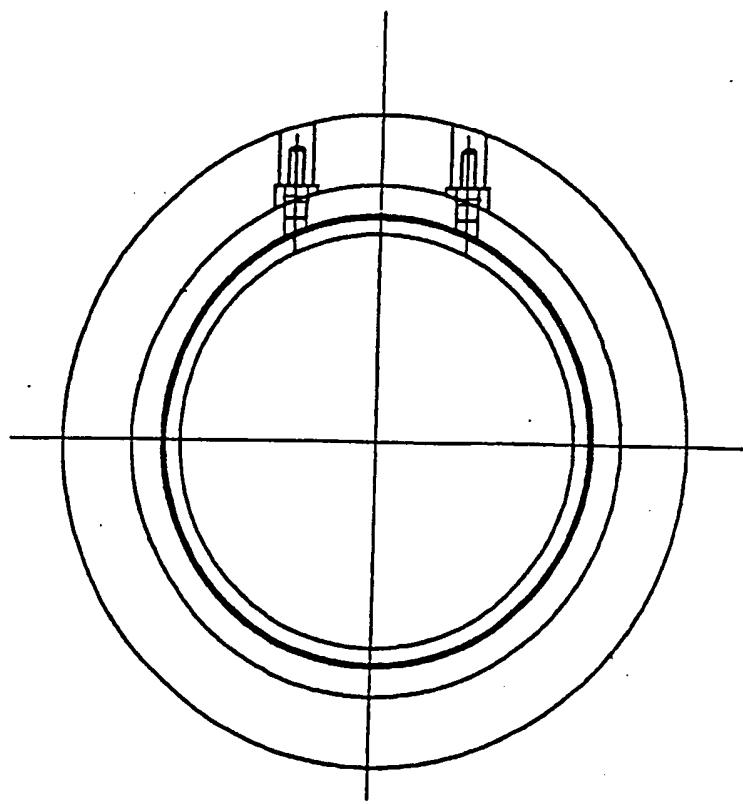


FIG 3B

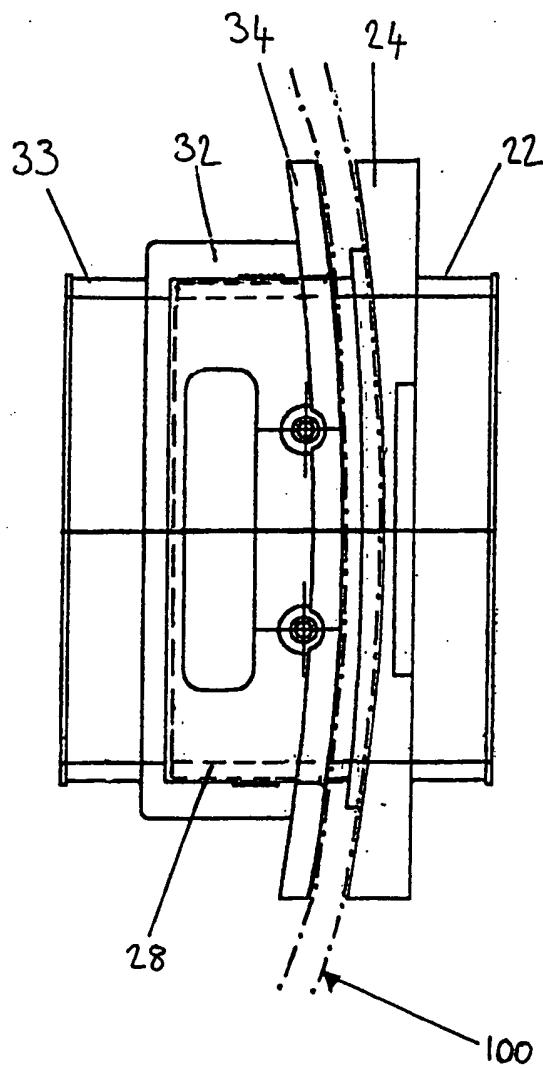


FIGURE 4

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/EP 03/04286

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16L47/03

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 332 255 A (PETROTECHNIK LTD) 16 June 1999 (1999-06-16) cited in the application claims 1,2,4; figures	1-14

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

8 document member of the same patent family

Date of the actual completion of the international search 14 January 2004	Date of mailing of the international search report 21/01/2004
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel: (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Budtz-Olsen, A

INTERNATIONAL SEARCH REPORT

Internal Application No
PCT/GB 03/04286

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
GB 2332255	A 16-06-1999	AT	244376 T	15-07-2003
		AU	1496899 A	28-06-1999
		DE	69816120 D1	07-08-2003
		DK	1038140 T3	27-10-2003
		EP	1038140 A1	27-09-2000
		WO	9930073 A1	17-06-1999